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1 / -	15.02.1995	all pages	initial issue
2 / -	01.03.1996	all pages	update for MSG phase B PDR
2 / A	04.04.1996	all pages	update for MSG phase B final study review
3	07.10.1996	all pages	completely restructured for PDR
3 / A	14.03.1997	all pages	updates acc. to design changes
3 / B	20.11.1997	all pages	CDR update
3 / C	20.01.1999	all pages	ΔCDR update

Table of Contents

1 INTRODUCTION

1.1 Scope

The scope of this document is to provide a single information source for all potential Microgravity Science Glovebox (MSG) users, with respect to the following information and requirements:

- general description of the MSG system and capabilities
- description of interfaces and utilities which are available for the MSG users
- detailed specification of interfaces and interface requirements to be considered by the MSG user

This document contains a description of a typical operation in the MSG (one performance of a small self-standing experiment and one servicing / repair task).

1.2 Objective

The Microgravity Science Glovebox (MSG) is a laboratory equipment of the International Space Station (ISS) and will provide scientific users with the opportunity to research in space. The MSG is one of the early European contribution items provided by ESA and, according to the baseline planning, will be accommodated in the NASA US-Laboratory.

The MSG is a Laboratory Support Equipment (LSE) and supports the operation of small experiments and handling / maintenance of experiments or equipment in a sealed environment. The MSG provides a double containment level for these operations by means of:

1. Providing a closed compartment, and
2. Filtering the internal air flow and maintaining a negative pressure inside the Working Volume, thus all leakage will result in cabin air entering the Glovebox and leaving as filtered air through the reference duct.

The MSG allows for handling of hazardous materials which, due to safety reasons, require a double containment. However, if the release of a fluid may lead to catastrophic consequences, an additional level of containment, than what the MSG can provide, shall be provided by the experiment.

As an LSE the MSG supports various experiments and scientific objectives which will be developed in the future and are not defined at this time. Therefore this Requirements Document is subject to review and revision as new developments occur. To assure the safe operation of an individual experiment inside the MSG, the experiment developer has to verify the compliance of potential experiment hazards considering MSG capabilities as additional hazard controls with respect to levels of containment.

Since developing experiments to be performed within MSG is a continuous process throughout the operational lifetime of MSG, each individual experiment has to be verified within the increment of its intended use. This MSG PAH defines only the facilities capabilities and constraints relevant for experiment performance.

For the experiment verification the following MSG safety relevant functional requirements shall be considered:

- The MSG shall provide a 99.97 percent efficient removal of particulate matter of 0.3 microns or larger from the Work Volume (WV) atmosphere.
- MSG shall provide the capability for manipulating single-containment inside the MSG WV (single containment will be provided by the experiment and is in addition to the MSG double containment) quantities of up to 50cc in volume of the materials as specified in section 4.8.
- The MSG shall provide an enclosed work volume that, during operation, shall maintain a negative pressure differential of no less than 0.5 inch (water gauge) relative to the cabin air pressure (1.3 mbar).

2 DOCUMENTS

2.1 Applicable Documents

No.	Document No.	Document Title	Iss.	Rev.	Date
[AD 1]	MSG-RIBRE-SPE-0001	MSG System Specification	3	C	22.12.1998
[AD 2]	MSG-RIBRE-RP-0002	MSG Design Definition Report	7	A	07.01.1999
[AD 3]	MSG-VE-TN-0013	MSG Payload Accommodation Handbook, Airlock	A	2	22.10.1997
[AD 4]	MSG-BE-TN-0006	MSG Payload Accommodation Handbook, Core Facility	1	0	14.03.1997
[AD 5]	NSTS 1700.7 incl. ISS Add.	Safety Policy and Requirements for Payload using the Space Transportation System, incl. Addendum 1			10.10.1990
[AD 6]	KHB 1700.7B	Space Transportation System Payload Ground Safety Handbook		B	18.02.1993
[AD 7]	SSP 50005	International Space Station Flight Crew Integration Standard (NASA-STD-3000/T)	00	B	21.11.1995
[AD 8]	SSP 57211	MSG Interface Control Document	Prel		30.09.1998
[AD 9]	MSG-BE-IC-0001	Interface Control Document MSG Data Handling System	B		27.10.1998
[AD 10]	SSP 30237	Space Station Requirements for Electromagnetic Emission and Susceptibility Requirements	C		5/96
[AD 11]	SSP 30243	Space Station Requirements for Electromagnetic Compatibility	D		5/96
[AD 12]	SSP 30240	Space Station Grounding Requirements	D		5/96

2.2 Reference Documents

No.	Document No.	Document Title	Iss.	Rev.	Date
{RD 1}	FED STD 209 E	Clean Room and Work Station Requirements, Controlled Environment			28.01.1991
{RD 2}	D 683-34513	SIR Drawer to Express Rack ICD			09.08.1995
{RD 3}	MSG-RIBRE-TN-0038	Analysis of Fire Detection and Suppression Approach in the MSG Working Volume	1	A	15.05.1997

3 MSG SYSTEM

3.1 System Overview

The MSG is integrated into an International Standard Payload Rack (ISPR), which is accommodated in the US Lab and optionally in the Columbus Orbital Facility (COF).

The MSG System consists of the following main hardware components:

3.1.1 Rack and Infrastructure

The MSG rack and infrastructure consists of the ISPR itself, secondary rack support structures and passive components, such as fluid lines, harness, etc.. Also several active components are part of the MSG infrastructure:

- Remote Power Distribution Assembly (RPDA) for power distribution, switching and circuit protection
- Avionics Air Assembly (AAA) for rack internal active air cooling / circulation
- Area Smoke Detection System (ASDA) in the rack internal air flow
- Rack Maintenance Switch Assembly (RMSA) as kill switch for immediately switching off primary power
- Rack Controller (R / C)

For the operation of the MSG system components the MSG-R / C provides the necessary MSG internal data interfaces for the acquisition of housekeeping / status information from, and for transmission of commands, to the MSG system components.

In addition to the internal interfaces, the MSG- R / C provides external interfaces to the ISS Data Handling System (ISS-DHS), the ISS Portable Computer System (PCS) and to the MSG test equipment and EGSE for remote operation and control of the MSG.

For operation and control of experiments inside the MSG Work Volume, the MSG-DHS serves as a relay station for transmission of data files to the experiment, which are received from external sources, such as the ISS-DHS, the EGSE, the PCS or test equipment.

Experiment data received by the MSG- R / C shall be transmitted to external interfaces, such as the interface to the ISS-DHS, the EGSE, the PCS or test equipment. An overview is presented in Figure 3.1-1.

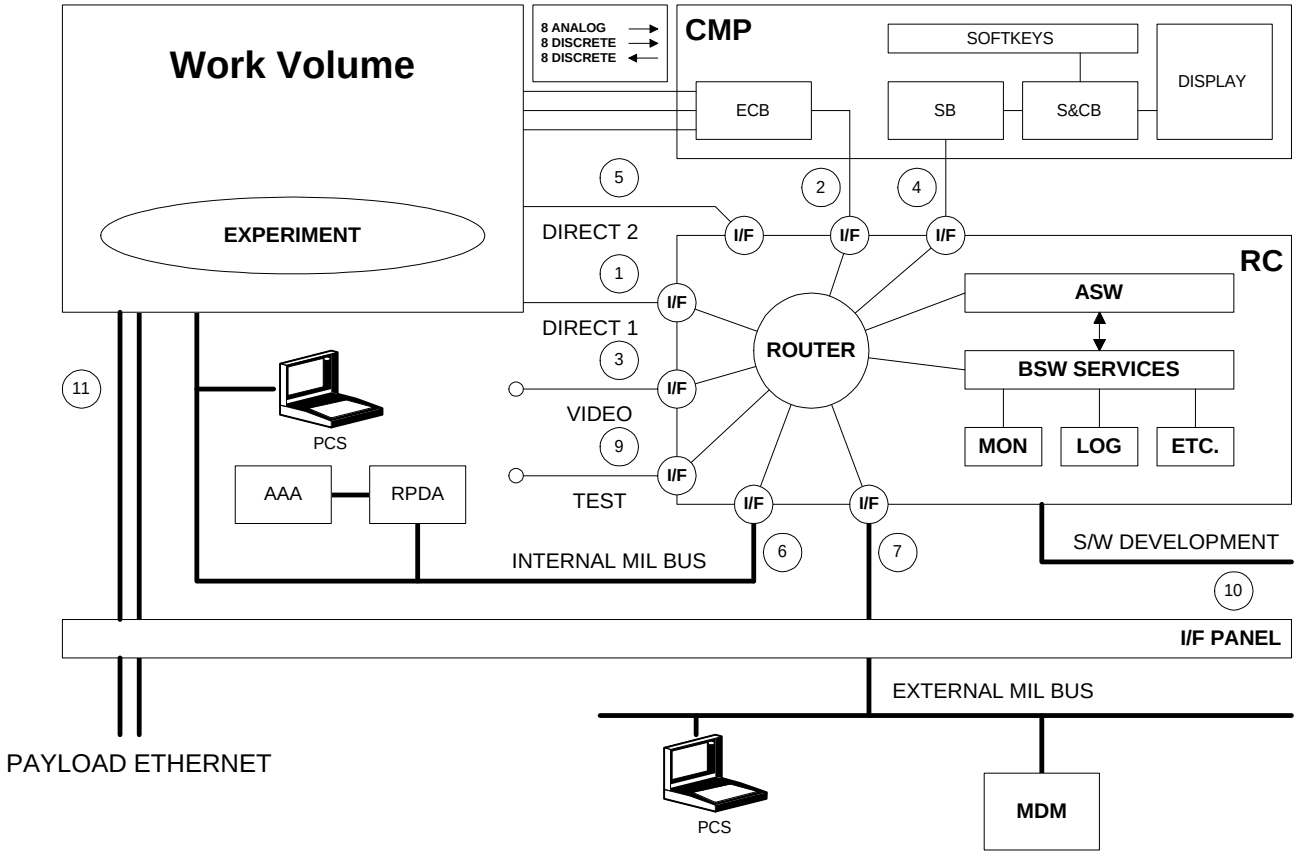


Figure 3.1-1: MSG Data Handling System Overview

3.1.2 Stowage Drawers

The MSG provides interface adapters according to the SIR specification {RD 2} to accommodate four passive stowage drawers.

3.1.3 Rack Front Panel

A rack front panel accommodates some test interface connectors and TBD control elements.

3.1.4 Core Facility

The Core Facility comprises several MSG components and interfaces with the ISPR structure via a sliding mechanism. The Core Facility main components are:

3.1.4.1 Work Volume (WV)

The WV is the real Glovebox of the MSG and allows manipulating of experiments via several glove ports. The rear wall inside the WV provides data, power and fluid interface connectors.

3.1.4.2 Airlock (AL)

The AL serves the transfer of equipment to the WV.

3.1.4.3 Video Unit (VU)

An MSG dedicated video system may be provided later in the project as an option.

3.1.4.4 Control & Monitoring Panel (CMP)

The CMP provides the majority of control and display elements which are required to operate and control the MSG operations. Switches, indicators and an LCD display with soft key control are located at the front panel. Experiment power will be switched either from the CMP or the WV Internal Control Panel (ICP).

3.1.4.5 Power Distribution and Control Box (PDC Box)

The PDC Box distributes and converts the incoming primary 120 VDC power and 28 VDC power which is required by the experiments and for MSG operation.

(Z1262330)

Figure 3.1-2: MSG System Overview

(MSG512B)

Figure 3.1-3: Airlock Overview

3.2 Core Facility Overview

The MSG Core Facility is an enclosure penetrated by gloves, which allows the operator to safely perform microgravity experiments and equipment service tasks which require a safe cabinet and manipulation by hand. All these tasks will be performed in the Core Facility Work Volume (WV), which forms together with the Air Handling Unit (AHU) the basic system called Glovebox (GB). The Command and Monitoring Panel (CMP), which is located on top of the Work Volume is connected to a dedicated E-box which contains all electronics for safety functions, sensors and controls. All Core Facility status, health and other data is monitored by the E-box and displayed by the CMP. An Airlock (AL) is located under the Work Volume. Basic lighting is provided for general operations, video and cleanliness inspection of the WV and AL. The WV is a contained cabinet of 255 liters, giving clear visual access to its internal through a large front window.

The Core Facility can be slid in and out of the rack to fixed positions, to improve the ergonomic and functional performance.

The principle of the Glovebox system is to provide a double containment by a sealed compartment and a negative pressure. The WV operates at a minimum of 1.3 mbar below cabin air pressure, assuring that all possibly polluted air coming from e.g. an experiment goes through the filters even in the event of a leak in the WV. Three independent Filter Banks, each with their dedicated fan take care of this task.

The GB AHU system has five operating modes: Normal, Open, Sealed, Donning and Manual. Normal Mode is when the Core Facility is operating under normal negative pressure and airflow conditions and the experiment in the WV is operating normally. The Core Facility operates in Open Mode when a sizable leak occurs, allowing cabin air to enter the WV. The fans will increase their speed automatically to assure the airflow through the filters. The Core Facility operates in Sealed Mode when the fans are switched off. This mode is used for stowage of the MSG or for experiments that do not require the second level of containment and can not be operated in an airflow. The Donning Mode is used to inflate the gloves so that the crew can easily don them. The Manual Mode allows individual settings for fan speed and other parameters in case this is required.

The Core Facility is equipped with several sensors to monitor temperature, gas, humidity and pressure inside the WV. A Heat Exchanger (HX) cools the WV air and an embedded coldplate, located in the WV floor, cools the experiment by conduction. Combined they can reject up to 1,000 W of experiment heat load.

Via two replaceable gloves at the front of the WV, operators can safely perform the handling of equipment. An Internal Control Panel (ICP) gives the operator the possibility to perform a number of CMP actions from the inside of the WV, without having to doff the gloves first.

Equipment can be transferred into the WV via either the loading ports or the AL. While operating the AL as a stand alone unit it makes use of its own filter system and the airflow provisions of the WV AHU. A glove can be installed into the AL front door for hands-on manipulation.

3.3 System Capabilities

The following system capabilities for operation / handling of experiments and ISS equipment are provided by the MSG. Detailed descriptions and interface specifications of these utilities / services is presented in the next sections.

3.3.1 System Capabilities Overview

- Work Volume
  - 255 liters
- Item Transfer / Glove Handling
  - Airlock
  - Side Loading Ports
  - Front / Side Glove Ports
- Air Circulation
  - variable flow circulation
  - air filtering
  - variable negative pressure
- Power Distribution
  - converted voltages provided in WV
  - US Lab primary power in WV
- Thermal Control
  - air cooling inside WV and AL
  - coldplate inside WV
- Video System (option)
- Illumination System
  - general and spotlight in WV
  - general in AL
- Data Connection inside WV
  - analog / digital output, digital input
  - 2 RS 422 interfaces
  - 2 MIL STD 1553 B
  - 2 ETHERNET feedthroughs
- Fluid Lines
  - Vacuum Exhaust
  - Vacuum Resource
  - GN2
- Mechanical Fastener System
  - inside WV and AL
  - pip-pins, bungee cords, clamps, etc.
- Cleaning Provisions
  - a set of standard cleaning equipment in MSG stowage drawer, see section 4.6.3.

3.4 Tools, Equipment, Experiment Requirements

In general, items which require to be operated and serviced in the MSG shall meet the physical interfaces of the Glovebox / Airlock and must be compliant with the capabilities of the MSG system. Items have to provide supporting equipment for connection to the MSG provided utilities, e.g. tubes / QDs, power / data cable / connectors, mounting equipment to the coldplate, etc., if these items are not part of the standard MSG Outfitting equipment.

Furthermore, it is required that in general all equipment to be operated and serviced within the MSG is designed and verified according to the design and verification requirements of the ISS program. Specific requirements for design, construction, safety and other objectives to user equipment are specified in the following sections.

Also it is required, that all equipment to be operated and serviced inside the MSG, is verified according to the MSG interface requirements as defined in the following sections. In addition, the experiment developer has to verify the design of the equipment / experiment according to the ISS program requirements only for those cases that direct interfaces to ISS are affected.

4 EXPERIMENT INTERFACES AND ACCOMMODATION

4.1 Structural / Mechanical

4.1.1 Experiment Containment

4.1.1.1 Work Volume

- The WV has an internal volume of 255 liter. The approx. dimensions of the work volume are:
  - width: 906 mm
  - depth (bottom): 500 mm
  - depth (top): 385 mm
  - height: 637 mm
- A set of drawings of the WV is attached, see section 7.
- The WV is hermetically isolated from the cabin, by means of seals and a negative pressure of ≥ 1.3 mbar provided in Normal and in Open mode, relative to cabin pressure.
- The WV provides the capability to transfer an experiment / equipment article of up to 406 mm diameter or a 350 mm by 300 mm to the inside.
- The MSG WV allows single containment quantity manipulation of up to 50 cc (except where noted otherwise) in volume as specified in section 4.8.1.
- The MSG WV provides the capability to maintain a class 100,000 environment as per FED-STD-209.
- The MSG WV provides a 99.97% efficient removal of all particulate mater of 0.3 micron or larger in aerodynamic diameter.

4.1.1.2 Airlock

The only interaction between the airlock and the payload is the attachment of the payload on the airlock tray for the transfer to the Work Volume.

The Airlock can handle equipment with the dimensions of 254 mm by 343 mm by 299 mm (26 liters).

4.1.2 Windows

4.1.2.1 Work Volume

The WV provides a wide angle Lexan Margard window at the front to allow direct clear view to the WV interior. Additional viewing capability is provided through the loading ports, which contain a large Lexan Margard window.

4.1.2.2 Airlock

The AL provides a Lexan window in the door for clear viewing inside the Airlock. A camera (TBC) can be mounted at the window.

4.1.3 Glove / Loading Ports

4.1.3.1 Glove Ports

At the front side of the WV, integrated into the window, two glove adapter rings are installed to mount 152.4 mm (6") diameter glove rings with permanently installed ambidextrous Neoprene gloves, with a length of 750 mm. Different glove material thickness between 0.13 to 0.4 mm is provided. Instead of glove rings, iris cuffs can be installed (not MSG provided). Small experiments, tools and equipment can be loaded into the WV through the glove ports.

Each of the two loading ports contains a 152.4 mm (6") glove adapter ring, to allow installation of gloves or iris cuffs. When gloves are installed in the loading ports, a total of four hands can manipulate the experiment. Specifically prepared 6" closed glove rings may be equipped with experiment dedicated feed through connectors, which can be installed into the glove ports instead of gloves.

All glove rings can easily be exchanged due to the quick release / install mechanism with positive locking.

4.1.3.2 Loading Ports

The two loading ports of the MSG WV are located one on each side wall of the WV. They can be opened by a simple rotating movement. Door sensors provide a positive feedback to the operator as well as the system when the ports are closed. To allow the loading ports to be opened, the MSG WV has to be slid outward to the maximum position. Tools, equipment and experiments can be loaded into the WV via the loading ports. The loading ports allow for objects to enter the WV up to a diameter of 406 mm (16"). Each loading port provides viewing capability and glove adapter rings as described above.

Additionally the airlock door may be used as possible loading port.

4.1.3.3 Airlock Glove Port

At the front side of the Airlock a door with a Lexan window and integrated 4" glove adapter ring is installed. The glove adapter ring provides the same features as the Work Volume glove adapter rings. The Airlock door can be opened left side and right side hinged. The front door can be removed and installed by rotating its position by 180° to obtain an alternative gloveport position. When the airlock top lid is open, the door of the airlock can not be opened in the normal operating mode (door interlocking principle). The payload inside the airlock can however be handled through the glove port of the airlock.

Movement of the tray is possible when the Airlock glove is inside. Retraction of the glove outside the airlock will however facilitate this movement. Regular retraction of the glove for transport to / from the glovebox may accelerate glove's wear.

4.1.4 Attachment Provisions

4.1.4.1 Work Volume

The WV interior provides three areas of pip-pin hole patterns in a square 70 mm grid:

1) WV floor, on the coldplate, 24 pip-pin holes are provided.
2) WV floor, on the AL top lid, 24 pip-pin holes are provided (ref. 4.1.4.2.1).
3) WV rear wall, left upper section, 20 pip-pin holes are provided.

The pip-pin interface is described in section 4.1.4.3. Drawings of location of the pip-pin pattern are provided in section 7.

Additionally 27 M6 fixation holes around each side port are provided. A respective drawing is also provided in section 7.

A set of bungee cords is provided for equipment restraining and further attachment hardware, like clamps, pin cushion, etc. are described in 4.6.5.

4.1.4.2 Airlock

The Airlock top lid as well as the tray system provide attachment provisions like the Work Volume.

- Tray: Equipment can be fixed to the tray (ref.4.1.4.2.2) by using bungee cords and a snap system.
- Top lid: The top lid top surface contains a hole pattern of 70 by 70 mm in which dismountable pip pin units can be installed for experiment fixation.

4.1.4.2.1 Airlock Top Lid

The Airlock provides a top lid which is in the closed position flat to the Work Volume floor surface. It is hinged to the right side of the Airlock and can be removed from the hinge and attached by a bungee cord pip pin to a dedicated place inside the Work Volume

4.1.4.2.2 Airlock Tray

The airlock tray is the only interface with the payload. All experiments, equipment or other material that has to be transferred from the US-Lab to the Glovebox Work Volume (or the other way around) will be attached on the tray.

The tray concept is given in figures in section 7. It consists of a removable tray, that can be placed inside the airlock on two different heights. This can be done from within the Work Volume and from the front of the airlock.

The actual interface of the tray with the payload consists of a mechanical system of bungee cords. Seven bungee cords are located on the tray, four more are provided in the stowage drawers. If the tray to payload interface requires a specific attachment method, this has to be provided by the experimenter.

For small payloads and equipment (e.g. a needle or bolt), a small transport container is provided, which can then be transferred to the Work Volume and opened there.

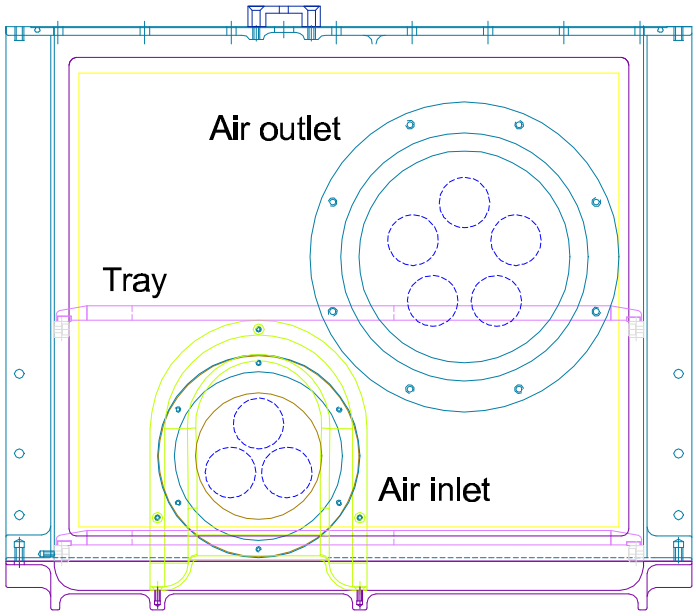


Figure 4.1-1: Tray Accommodated Inside the Airlock

4.1.4.3 Pip-pins

The experiments are mounted at the work surfaces inside the WV as describe in section 4.1.4.1 and 4.1.4.2. A pip-pin insert can be placed into a threaded hole in the surface. With a dedicated pip-pin the experiment can be mounted to this surface. There are several types of pippins available with respect to the grip height of the pip-pin. There is a ring available at the pip-pin handle to tether the pip-pin to a experiment. The dedicated experiment pip-pins should be provided with the experiment and being tethered.

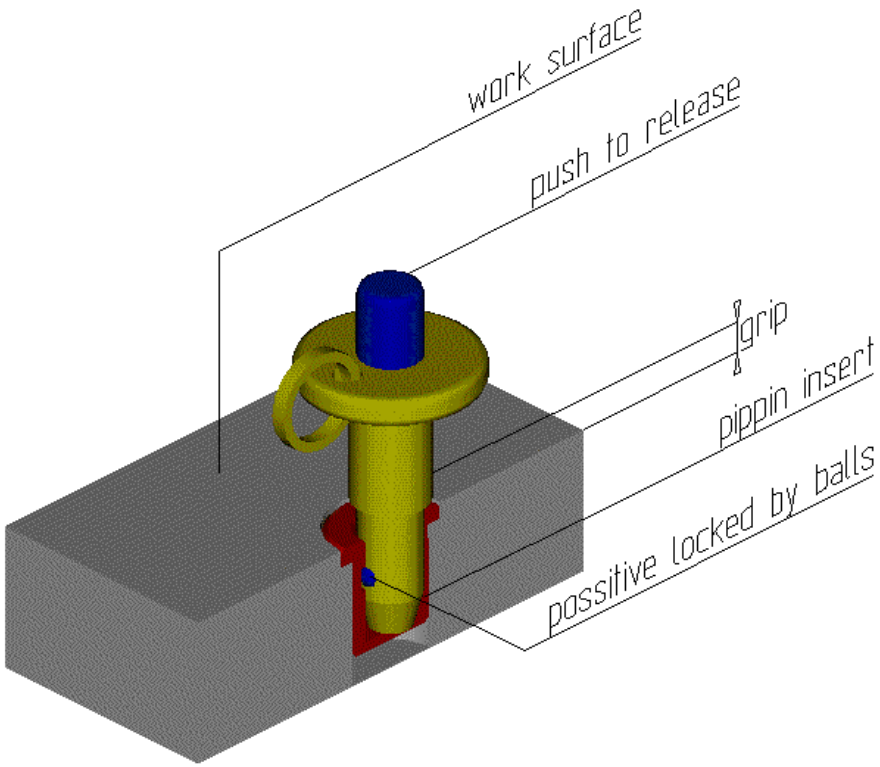


Figure 4.1-2: Pip-pin Configuration

The pip-pins used in the WV are of a single acting quick release type and are positively locking.

The types used are the LG-type pip-pins supplied by Lockwell, general nominal shank diameter 1/4".

Detailed drawings of the interfaces are attached in section 7.

4.2 Thermal / Fluid Interfaces

The user shall limit the heat rejection for all equipment inside the Work Volume to 1,000 W.

4.2.1 Air Circulation System (ACS)

4.2.1.1 Work Volume

The WV air circulation is established by three independent fans. These fans pull the air through the filter units as described earlier. The airflow serves three purposes:

1) Provide negative pressure inside the WV.
2) Provide air circulation for experiment air cooling.
3) Provide air circulation for WV air filtration.

The filtration system provides performance for particulate removal as described above, filtration of single spillage of materials as described above and oxidation of CO to CO_2 by means of a built-in catalyst.

Due to the hygroscopic nature of the filters, the humidity inside the WV will be maintained at or below cabin level.

The WV maximum airflow is 1200 l / min and can be controlled between 15 and 100% by selection on the CMP.

Airflow Velocity inside the WV:

SEALED MODE:	v = 0
DONNING MODE:	can be preset between 0 and 0.02 m^3/s (0.044 m / s at centerline of WV)
OPEN MODE:	depends on leak-size
NORMAL MODE:	maximum: 0.02 m^3/s (0.044 m / s at centerline of WV) can be varied between 15% and 100 %. Calculation without experiment inside WV.

4.2.1.2 Airlock

No active thermal conditioning of the airlock is foreseen. The AL air circulation system is part of the Glovebox ACS and provides conditioning of the Airlock atmosphere. Therefore the temperature in the airlock will be the ambient one. After a relief and a check valve the ACS ducting splits sending conditioned air to the Work Volume and to the Airlock. Air diverted to the Airlock will pass a redundant set of flapper valves, the Airlock internal volume, a filter unit and through another flapper valve enters the Glovebox Work Volume. The filter used in the AL is the same type as used in the WV.

Air flow rate: 1 l / s (fan speed can be adjusted at the CMP)
Inlet area: 0.005 m^2

4.2.2 Work Volume Air Cooling

In the AHU, an air to water HX is installed, capable of cooling up to 200 W of experiment heat load. The maximum cooling capacity is reached with the maximum air circulation rate. The WV air cooling is continuously active.

4.2.2.1 Experiment Requirements

1) The experiment shall have a maximum heat rejection via air cooling of 200 W.

4.2.3 Water Cooling (Coldplate)

The MSG contains a coldplate in the bottom of the WV (350 mm x 400 mm), which is capable of removing up to 800 W from an experiment mounted on the coldplate. This coldplate is located on the left side of the WV floor.

The surface of the coldplate is flat (< 0.1 mm). Connection is made by pip-pins on a 70 mm x 70 mm grid pattern.

4.2.3.1 Experiment Requirements

1) The experiment shall have a maximum heat rejection via water cooling of 800 W.
2) The experiment shall provide a flatness < 0.1 mm to provide for full contact mounting.
3) The experiment shall provide pip-pins to interface with the 70 mm by 70 mm grid in the coldplate.
4) The experiment shall provide TBD heat conductivity to the coldplate.
5) The experiment shall provide for an equal heat distribution over the coldplate.

4.2.4 Vacuum Exhaust

A quick disconnect (QD) and shut-off valve interface for interfacing directly with the ISS Vacuum Exhaust System (VES) is provided inside the WV. This interface can be used by the experiment. The flow is limited to 25 normal liters per second.

The Vacuum Exhaust System interface to the experiment is a QD inside the WV. This QD is a swagelock body SS-QC8-B1-810 K1, 0.5" color code white. The system becomes active after opening the shut off valve inside the WV.

4.2.4.1 Experiment Requirements

1) The experiment shall comply with the applicable requirements of the MSG ICD [AD 8].
2) The experimenter shall provide a swagelock stem SS-QC8-D1-810K1 to interface with this system. In the part number the D indicates a double end shut off, the K indicates the key of this interface.
3) The experiments shall provide an additional control (valve) for the use of the Vacuum Exhaust System.
4) Maximum leak rate: 2×10^{-3} mbar l / sec.
5) The experiment shall ensure that the Vacuum Exhaust Valve will not be blocked.
6) The experiment shall limit the vented exhaust gas to a pressure of 276 kPa (40 psia) or less at the WV interface.
7) Integrated experiment volumes connected to the VES shall be designed to a maximum design pressure of at least 276 kPa (40 psia) with safety factors in accordance with SSP 52005 paragraph 5.1.3.
8) The initial temperature range of exhaust gases shall be between 16 °C (60 °F) to 45 °C (113 °F).
9) The initial dewpoint of exhaust gases shall be limited to 16 °C (60 °F) or less.
10) Vented exhaust gases shall be limited to less than 25% (TBC) of the lower explosive limit for the gas mixture.
11) The experiments shall specify the materials to be dumped through the vacuum line.
12) If experiments dump toxic materials through the vacuum line they shall provide an absorbing filter.
13) Exhaust gases shall be compatible with paragraph 3.4 of SSP 30426, Space Station External Contamination Control Requirements, for molecular column density, particulates and deposition on external Space Station surfaces.
    A list of acceptable exhaust gases with verified compatibility to the VES will be documented in the US-Lab Payload Accommodation Handbook.

4.2.5 Vacuum Resource

A quick disconnect (QD) and shut-off valve interface for interfacing directly with the ISS Vacuum Resource System (VRS) is provided inside the WV. This interface can be used by the experiment.

The Vacuum Resource system interface is a QD inside the WV. This QD is a swagelock body SS-QC8-B1-810K6, color black 0.5". The system becomes active after opening the shut off valve inside the WV.

4.2.5.1 Experiment Requirements

1) The experiment shall comply with the applicable requirements of the MSG ICD [AD 8].
2) The experimenter has to provide a swagelock stem SS-QC8-D1-810K6 to interface with this system. In the part number the D indicates a double end shut off, the K indicates the key of this interface.
3) The experiments shall provide an additional control (valve) for the use of the Vacuum Resource System.
4) Maximum leak rate: 2×10^{-3} mbar l / sec.
5) The experiment shall ensure that the Vacuum Exhaust Valve will not be blocked.
6) The experiment shall limit the vented VRS gases to a pressure of 10^{-3} torr or less at the WV interface.
7) Integrated experiment volumes connected to the VRS shall be designed to a maximum design pressure of at least 276 kPa (40 psia) with safety factors in accordance with SSP 52005 paragraph 5.1.3.
8) The integrated experiment shall limit the gas throughput to the VRS to less than 1.2×10^{-3} torr liters / second.

4.2.6 Nitrogen Interface

A quick disconnect and a needle valve interface is provided in the Work Volume. This interface is directly coupled via the UIP to the US-Lab Nitrogen System.

The Quick Disconnect inside the Work Volume interfacing with the US-Lab Nitrogen System is a swagelock body SS- QC4-B1-400, 0.25". No key and no color code. The part number D indicates a double end shut-off, the K indicates the key of this connection. The system will be activated after opening a dedicated shut-off valve close to the QD.

4.2.6.1 Experiment Requirements

1) The experiment has to comply with the applicable requirements of the MSG ICD [AD 8].
2) The experimenter has to provide a swagelock stem SS-QC4-D1-400 to interface with this system. In the part number the D indicates a double end shut off, the K indicates the key of this interface.
3) The experiment shall provide a means to control the flow of nitrogen to not exceed 5.43 kg / hr (12 lb / hr) when connected to the nitrogen interface operating pressure range of 517 to 827 kPa (75 to 120 psia).
4) For the use of the nitrogen system the following three controls are required by the experiment:
   a) oxygen sensor inside the WV
   b) wait one minute while the WV fans are running in Normal Mode
   c) verify reading of oxygen sensor above 10.5% O2 before opening WV
5) The MDP of the integrated experiment nitrogen system shall be 1,379 kPa (200 psia).
6) The integrated experiment nitrogen system shall be designed for a nitrogen supply temperature range of 15.6 °C to 45 °C (60 °F to 113 °F).
7) Maximum leak rate: 3×10^{-3} mbar l / sec.

4.3 Electrical Power

Experiment primary and secondary power is distributed in the Work Volume. The power outlets can be activated either via the dedicated CMP switches or remote controlled from inside the Work Volume.

The user shall limit the power draw from all WV experiment power consumers (primary and secondary) to 1,000 W.

4.3.1 Experiment Primary Power

The experiment 120V DC / 1,000 Watt is supplied on a MS27656P17F6S connector in the WV rear wall, with the following contact assignments. The user of this connector shall provide means to interface with this connector.

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J302, EXP. OUTLET 3, 120V		CONNECTOR TYPE: MS27656P17F6S
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**
A	12	+120V DC Primary Power
B	12	RTN for 120V DC Primary Power
C	12	Overall Shield
D	12	INHIBIT J302
E	12	RTN for INHIBIT J302
F	12	Chassis J302

Table 4.3-1: Experiment Primary Power Contact Assignment

4.3.1.1 Experiment Requirements

1) Contacts D and E have to be bridged inside the experiment system to assure proper operation of the inhibit.
2) Experimenter provided connector type: TBD
3) Experiment contact assignments shall be compatible with the above Table 4.3-1.
4) Maximum power: 1,000 W for all WV experiment power consumers
5) Maximum inrush current: TBD

4.3.2 Experiment Secondary Power

Secondary experiment power is supplied in +5 VDC / 4 A, -12 VDC / +12 VDC / 2 A and +28 VDC / 7 A on two MS27656P21F11S connectors in the WV rear wall, with the following contact assignments. The user shall provide means to interface with these connectors.

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J303, EXP. OUTLET 1		CONNECTOR TYPE: MS27656P21F11S
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**
A	12	+28 V Power Exp. Sec. 1
B	12	RTN 28 V Power Exp. Sec. 1
C	12	+12 V Power Exp. Sec. 1
D	12	-12 V Power Exp. Sec. 1
E	12	RTN 12 V Power Exp. Sec. 1
F	12	+5 V Power Exp. Sec. 1
G	12	RTN 5 V Power Exp. Sec. 1
H	12	Overall Shield J303
J	12	INHIBIT J303
K	12	RTN for INHIBIT J303
L	12	Chassis J303

Table 4.3-2: Experiment Secondary Power Contact Assignment (EXP. OUTLET 1)

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J325, EXP. OUTLET 2		CONNECTOR TYPE: MS27656P21F11S
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**
A	12	+28 V Power Exp. Sec. 2
B	12	RTN 28 V Power Exp. Sec. 2
C	12	+12 V Power Exp. Sec. 2
D	12	-12 V Power Exp. Sec. 2
E	12	RTN 12 V Power Exp. Sec. 2
F	12	+5 V Power Exp. Sec. 2
G	12	RTN 5 V Power Exp. Sec. 2
H	12	Overall Shield J325
J	12	INHIBIT J325
K	12	RTN for INHIBIT J325
L	12	Chassis J325

Table 4.3-3: Experiment Secondary Power Contact Assignment (EXP. OUTLET 2)

4.3.2.1 Experiment Requirements

1) Contacts J and K have to be bridged inside the experiment system to assure proper operation of the inhibit.
2) Experimenter provided connector type: TBD
3) Experiment contact assignments shall be compatible with the above Table 4.3-2 and / or Table 4.3-3.
4) Maximum power: 1,000 W for all WV experiment power consumers
5) Maximum inrush current: TBD

4.4 Command and Data Handling

The following general requirements are applicable for experiments:

1) For fire detection the requirements shall include as a minimum a temperature measurement in their experiment in compliance with NSTS 1700.7, ISS Addendum [AD 5]. Additional parameter monitoring depends on the experiment and has to be coordinated with the PSRP.

4.4.1 Digital I/O and Analog In

The experiment data collection and discrete command interface is provided at connectors J301 and J319 on the WV rear wall, and provides:

8 analog in	-	differential, -10 to +10 V, 12 bit resolution, for experiment data
8 digital in	-	single ended, 0..0.8 V for logical 0, 3.6..10 V for logical 1, for experiment data
8 digital out.	-	single ended, 0..0.8 V for logical 0, 3.6..10 V for logical 1, for experiment commanding

MSG provides a maximum aggregate sampling rate of 1,500 samples/s [TBC] on 3 dedicated analog signals with a 12 bit resolution.

Experiment data collection and command is offered on a MS27656P15F35SA connector with the following contact assignments. The user has to provide means to interface with these connectors.

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J301, EXP. DATA 1		CONNECTOR TYPE: MS27656P15F35SA
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**
1	22D	Exp. Data Analog in 0+
2	22D	Exp. Data Analog in 0-
3	22D	Exp. Data Analog in 1+
4	22D	Exp. Data Analog in 1-
5	22D	Exp. Data Analog in 2+
6	22D	Exp. Data Analog in 2-
7	22D	Exp. Data Analog in 3+
8	22D	Exp. Data Analog in 3-
9	22D	RTN Analog in (1-8)
10	22D	Exp. Data Digital in 0
11	22D	Exp. Data Digital in 1
12	22D	Exp. Data Digital in 2
13	22D	Exp. Data Digital in 3
14	22D	N.C.
15	22D	N.C.
16	22D	N.C.
17	22D	N.C.
18	22D	RTN Digital in (10-13)
19	22D	Exp. Data Digital out 0
20	22D	Exp. Data Digital out 1
21	22D	Exp. Data Digital out 2
22	22D	Exp. Data Digital out 3
23	22D	N.C.
24	22D	N.C.
25	22D	N.C.
26	22D	N.C.
27	22D	RTN Digital out (19-22)
28	22D	N.C.
29	22D	N.C.
30	22D	N.C.
31	22D	N.C.
32	22D	N.C.
33	22D	N.C.
34	22D	N.C.
35	22D	N.C.
36	22D	Overall Shield (pin 9-13)
37	22D	Overall Shield (pin 18-22, 27)

Table 4.4-1: Digital I/O and Analog In Contact Assignment (EXP. DATA 1)

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J319, EXP. DATA 2		CONNECTOR TYPE: MS27656P15F35SA
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**
1	22D	Exp. Data Analog in 4+
2	22D	Exp. Data Analog in 4-
3	22D	Exp. Data Analog in 5+
4	22D	Exp. Data Analog in 5-
5	22D	Exp. Data Analog in 6+
6	22D	Exp. Data Analog in 6-
7	22D	Exp. Data Analog in 7+
8	22D	Exp. Data Analog in 7-
9	22D	RTN Analog in (1-8)
10	22D	Exp. Data Digital in 4
11	22D	Exp. Data Digital in 5
12	22D	Exp. Data Digital in 6
13	22D	Exp. Data Digital in 7
14	22D	N.C.
15	22D	N.C.
16	22D	N.C.
17	22D	N.C.
18	22D	RTN Digital in (10-13)
19	22D	Exp. Data Digital out 4
20	22D	Exp. Data Digital out 5
21	22D	Exp. Data Digital out 6
22	22D	Exp. Data Digital out 7
23	22D	N.C.
24	22D	N.C.
25	22D	N.C.
26	22D	N.C.
27	22D	RTN Digital out (19-22)
28	22D	N.C.
29	22D	N.C.
30	22D	N.C.
31	22D	N.C.
32	22D	N.C.
33	22D	N.C.
34	22D	N.C.
35	22D	N.C.
36	22D	Overall Shield (pin 9-13)
37	22D	Overall Shield (pin 18-22, 27)

Table 4.4-2: Digital I/O and Analog In Contact Assignment (EXP. DATA 2)

4.4.1.1 Experiment Requirements

1) Experimenter provided connector type: TBD
2) Experiment contact assignments shall be compatible with the above Table 4.4-1.
3) Analog input: differential, -10 to +10 V
4) Digital input: single ended, 0..0.8 V for logical 0, 3.6..10 V for logical 1
5) Digital output: single ended, 0..0.8 V for logical 0, 3.6..10 V for logical 1

4.4.2 RS 422 Serial Interface

For experiment use two RS 422 serial interface connectors are provided at connector J305 and J311, both type MS27656P9F35S, on the WV rear wall.

The RS422 connection is a 4-wire point-to-point link of two users. The pin-layout for the connectors is given in Figure 4.4-1 and Figure 4.4-2 below.

CONTACT ASSIGNMENTS FOR CONNECTOR			
CONNECTOR LABEL: J305, WV RS422		CONNECTOR TYPE: MS27656P9F35S	
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**	
1	22D	RX+	RS422 WV I/F #5
2	22D	RX-	RS422 WV I/F #5
3	22D	RX Shield	RS422 WV I/F #5
4	22D	TX+	RS422 WV I/F #5
5	22D	TX-	RS422 WV I/F #5
6	22D	TX Shield	RS422 WV I/F #5

Figure 4.4-1: RS422 J305 Connector Contact Assignment

CONTACT ASSIGNMENTS FOR CONNECTOR			
CONNECTOR LABEL: J311, WV RS422		CONNECTOR TYPE: MS27656P9F35S	
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**	
1	22D	RX+	RS422 WV I/F #1
2	22D	RX-	RS422 WV I/F #1
3	22D	RX Shield	RS422 WV I/F #1
4	22D	TX+	RS422 WV I/F #1
5	22D	TX-	RS422 WV I/F #1
6	22D	TX Shield	RS422 WV I/F #1

Figure 4.4-2: RS422 J311 Connector Contact Assignment

4.4.2.1 Experiment Requirements

1) Experimenter provided connector type: TBD
2) Experiment contact assignments shall be compatible with the above table.

4.4.3 MIL STD 1553B Interface

A MIL STD 1553B interface is provided at connectors J318 (MIL 1553B - A) and J314 (MIL 1553B - B) on the WV rear wall.

The MIL-STD-1553B bus uses PV-TBF14-19PS type connectors in a terminated bus configuration. Each user is connected into the system using a connection block with an extra possibility for connection of a terminator stub, as shown in Figure 4.4-3 below.

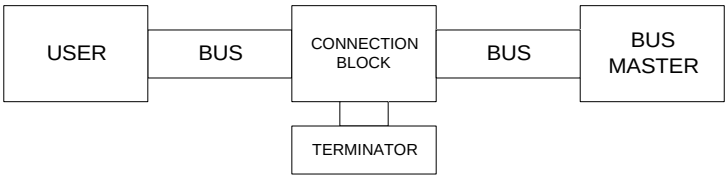


Figure 4.4-3: MIL-STD-1553B Bus Connection Example

The layout of the MIL Bus interface connectors is depicted in Figure 4.4-4, the contact assignment is given in Figure 4.4-5 and Figure 4.4-6.

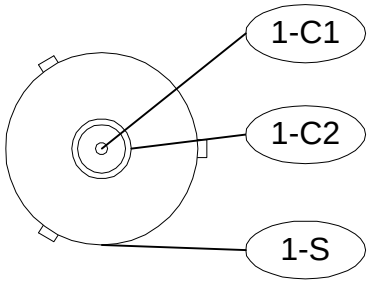


Figure 4.4-4: MIL-STD-1553B Connector Pin Layout

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J318, MIL 1553B - A (Main)		CONNECTOR TYPE: BJ79HS-30
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**
1-C1	Twinax	MIL Bus MAIN+
1-C2	Twinax	MIL Bus MAIN-
1-S	Twinax	Shield MIL Bus MAIN

Figure 4.4-5: MIL Bus J318 Connector Contact Assignment

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J314, MIL 1553B - B (Redundant)		CONNECTOR TYPE: BJ79HS-30
CONTACT #	**CONTACT AWG**	**FUNCTION / DESCRIPTION**
1-C1	Twinax	MIL Bus RED+
1-C2	Twinax	MIL Bus RED-
1-S	Twinax	Shield MIL Bus RED

Figure 4.4-6: MIL Bus J314 Connector Contact Assignment

4.4.3.1 Experiment Requirements

1) Experimenter provided connector type: TBD
2) Experiment contact assignments shall be compatible with the above table.

4.4.4 ETHERNET Interface (physical)

One ETHERNET interface is provided at connector J320 on the WV rear wall.

The connector provides a direct interface to the ISS ETHERNET and is not supported by the MSG Data Handling System.

The ETHERNET is offered on a D38999/20FG75S connector with the contact assignments as per Table 4.4-3. The user has to provide means to interface with this connector.

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J320, Ethernet		CONNECTOR TYPE: D38999/20FG75S
CONTACT #	**CONTACT AWG**	**FUNCTION/DESCRIPTION**
A-C1	Twinax	Ethernet 1 TX+
A-C2	Twinax	Ethernet 1 TX-
A-S	Twinax	Ethernet 1 Shield TX
B-C1	Twinax	Ethernet 1 RX+
B-C2	Twinax	Ethernet 1 RX-
B-S	Twinax	Ethernet 1 Shield RX
C-C1	Twinax	Ethernet 2 TX+
C-C2	Twinax	Ethernet 2 TX-
C-S	Twinax	Ethernet 2 Shield TX
D-C1	Twinax	Ethernet 2 RX+
D-C2	Twinax	Ethernet 2 RX-
D-S	Twinax	Ethernet 2 Shield RX

Table 4.4-3: ETHERNET Interface Contact Assignment

4.4.4.1 Experiment Requirements

1) Experimenter provided connector type: TBD
2) Experiment contact assignments shall be compatible with the above table.

4.4.5 Software Definition

The MSG provides three software interfaces for experiments:

- RS 422
- MIL-STD-1553B bus
- ETHERNET.

The experiment interfaces to the MSG software are extensively described in the software ICD [AD 9]: Interface Control Document MSG Data Handling System.

4.4.5.1 Experiment Requirements

1) The experiments have to comply with the data link protocol(s) and message formats as defined in the MSG S/W ICD [AD 9].

4.5 Video System

A video system will be provided in the MSG. The entire system is currently under definition

However, the feedthroughs for video connectors are already implemented in the design. They are located in the upper left and right corners of the WV.

The connector type for all four connectors (J306, J307, J308, J309) is SGJ-2B 3-19CLL-PV (LEMO). The contact assignment is not defined by MSG.

4.5.1.1 Experiment Requirements

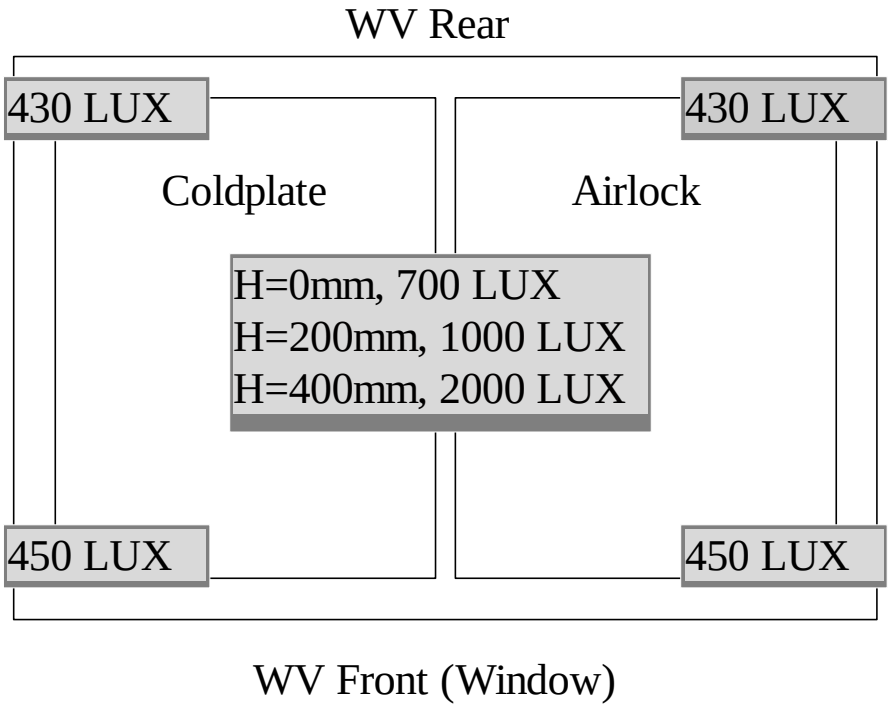
TBD

4.6 Environments

4.6.1 Illumination

4.6.1.1 WV Illumination

An illumination system of three identical illumination units is accommodated in the WV top wall. It provides up to 1,000 lux maximum illumination at approximately 200 mm above the WV floor. The general illumination is variable in intensity. At the maximum intensity the color temperature is ≥ 2,750 K, with a color rendering index (RA) of 85 or better.



Light Intensity at floor areas were measured after 2 hours burning of the lamps without external light sources.

Figure 4.6-1: Light Intensity Measured at Several WV Floor Areas

4.6.1.1.1 Experiment Requirements

1) In case that the experiment requires additional lighting, the spotlight can be used or the experiment can provide its dedicated illumination source.

4.6.1.2 AL Illumination

An Illumination System is accommodated inside the Airlock at the left wall. It provides 323 lux general working light. Switching the airlock illumination on or off can be done through a switch on the CMP or the ICP.

4.6.1.2.1 Experiment Requirements

There are no requirements to the experiment concerning AL illumination

4.6.1.3 Spot Light Illumination

A spotlight, variable in light intensity with a maximum of 1,000 lux at an illuminated area of ∅10 cm, is provided by MSG. The spot light connector can be installed directly on the J304 connector on the rear side of the WV, or if the ICP is connected, on the J334 connector of the ICP. Both connector types are MS27656P15F35S.

If the MSG provided spotlight does not meet the experiment needs, a dedicated experiment spot light can be installed, provided it meets the requirements below.

The spotlight interface is offered on a connector with the following contact assignments. The user has to provide means to interface with this connector.

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J304, ICP		CONNECTOR TYPE: MS27656P15F35S
CONTACT #	**INTERNAL WIRE AWG**	**FUNCTION / DESCRIPTION**
1	22D	N / A for experiments
2	22D	N / A for experiments
3	22D	N / A for experiments
4	22D	N / A for experiments
5	22D	N / A for experiments
6	22D	N / A for experiments
7	22D	N / A for experiments
8	22D	N / A for experiments
9	22D	N / A for experiments
10	22D	N / A for experiments
11	22D	N / A for experiments
12	22D	N / A for experiments
13	22D	N / A for experiments
14	22D	N / A for experiments
15	22D	N / A for experiments
16	22D	N / A for experiments
17	22D	N / A for experiments
18	22D	N / A for experiments
19	22D	N / A for experiments
20	22D	N / A for experiments
21	22D	N / A for experiments
22	22D	N / A for experiments
23	22D	INHIBIT 2 (11 switches) (link to 25)
24	22D	Chassis
25	22D	RTN (link to 23)
26	22D	INHIBIT 1 (+12 V Power)
27	22D	RTN for +12V / 2A
28	22D	+12 V / 2A Power
29	22D	N / A for experiments
30	22D	N / A for experiments
31	22D	N / A for experiments
32	22D	N / A for experiments
33	22D	N / A for experiments
34	22D	N / A for experiments
35	22D	N / A for experiments
36	22D	N / A for experiments
37	22D	N / A for experiments

Table 4.6-1: ICP Contact Assignment

CONTACT ASSIGNMENTS FOR CONNECTOR		
CONNECTOR LABEL: J334, Spotlight Interface		CONNECTOR TYPE: MS27656P15F35S
CONTACT #	**INTERNAL WIRE AWG**	**FUNCTION / DESCRIPTION**
1	22D	N / A for experiments
2	22D	N / A for experiments
3	22D	N / A for experiments
4	22D	N / A for experiments
5	22D	N / A for experiments
6	22D	N / A for experiments
7	22D	N / A for experiments
8	22D	N / A for experiments
9	22D	N / A for experiments
10	22D	N / A for experiments
11	22D	N / A for experiments
12	22D	N / A for experiments
13	22D	N / A for experiments
14	22D	N / A for experiments
15	22D	N / A for experiments
16	22D	N / A for experiments
17	22D	N / A for experiments
18	22D	N / A for experiments
19	22D	N / A for experiments
20	22D	N / A for experiments
21	22D	N / A for experiments
22	22D	N / A for experiments
23	22D	N / A for experiments
24	22D	Chassis
25	22D	INHIBIT 2 (11 switches) (also P304-23)
26	22D	INHIBIT 1 (+12 V / 2A Power)
27	22D	RTN for +12V / 2A Power
28	22D	+12 V / 2A Power
29	22D	N / A for experiments
30	22D	N / A for experiments
31	22D	N / A for experiments
32	22D	N / A for experiments
33	22D	N / A for experiments
34	22D	N / A for experiments
35	22D	N / A for experiments
36	22D	N / A for experiments
37	22D	N / A for experiments

Table 4.6-2: Spot Light Illumination Contact Assignment at ICP

4.6.1.3.1 Experiment Requirements

1) For the layout of the ICP inhibit see Figure 4.6-2
2) Experimenter provided connector type: TBD
3) Experiment contact assignments shall be compatible with the above table.
4) Maximum power: 12V / 2A.
5) For thermal reasons the spotlight shall not be covered while on.

(436.900.74)

Figure 4.6-2: ICP Inhibit Layout

4.6.2 Contamination

Dust particles, fluids and other contamination, generated by the experiment shall not exceed TBD values.

4.6.2.1 Experiment Requirements

TBD.

4.6.3 Cleaning Provisions

The MSG provides a set of standard cleaning provisions:

- alcohol wipes
- tissues
- optical cleaning sterets
- waste bags
- filter cartridges for liquid spills
- scavenger pump
- extension hose
- suction nozzle
- particle catcher
- cleaning nozzle

Details are described in the MSG Design Definition Document [AD 2].

4.6.3.1 Experiment Requirements

1) In case the experiment requires other cleaning provision than the ones listed above, they have to be provided by the user.
2) If experiments intend to use materials not on the standard list (see section 4.8.1), they have to provide for their own cleaning tools / wipes etc. in case of spillage and take care of waste disposal.

4.6.4 EMI / EMC

In order to avoid electromagnetic interference with the MSG system and other equipment inside the US Lab the experiment shall comply to the following requirements.

4.6.4.1 Experiment Requirements

1) During operation the experiment shall be connected to the bonding stub inside the WV.
2) The experiments shall meet the EMI requirements of SSP 30237 [AD 10].
3) The experiments shall meet the EMC requirements of SSP 30243 [AD 11].

4.6.5 Microgravity Environment

The microgravity level at the experiment attachment points inside the Work Volume is TBD.

4.6.5.1 Experiment Requirements

1) Experiments operating equipment causing vibratory disturbances must meet the following requirements: TBD

4.6.6 Experiment Generated Noise

4.6.6.1 Experiment Requirements

An experiment which operates for more than 8 hours in a 24 hour period and generates a Sound Pressure Level (SPL) greater than or equal to 34 dBA is classified as a Continuous Noise Source. An experiment which is classified as a Continuous Noise Source must either meet the limits defined in Table 4.6-3 or demonstrate that the cumulative time it generates noise above the limits defined in Table 4.6-3 during a 24 hour period meets the Intermittent Noise Limits defined in Table 4.6-4.

Overall Experiment A-Weighted SPL [dBA]	
Frequency Band [Hz]	**Integrated Experiment SPL Limit [dB]**
63	61
125	53
250	47
500	42
1,000	38
2,000	36
4,000	35
8,000	34

Note: The experiment SPL is to be measured at a distance of 0.6 meters from the test article.

Table 4.6-3: Experiment Continuous Noise Requirements

An integrated experiment which operates for less than 8 hours in a 24 hours period and generates a SPL greater than or equal to 34 dBA measured at a distance of 0.6 meters from the noisiest part of the experiment is classified as an Intermittent Noise Source. An experiment classified as an Intermittent Noise Source must meet the total experiment A-weighted SPL limits defined in Table 4.6-4.

Maximum Experiment Noise Duration Per 24 Hour Period	Total Experiment A-Weighted SPL [dBA] Limit
8 Hours	46
7 Hours	47
6 Hours	48
5 Hours	49
4 Hours	51
3 Hours	54
2 Hours	57
1 Hour	62
30 Minutes	66
15 Minutes	69
5 Minutes	73
2 Minutes	75
1 Minute	76
Not Allowed	77

Table 4.6-4: Experiment Intermittent Noise Requirements

4.7 MSG Stowed Outfitting Equipment

Experiments requiring individual stowage need to address their requirements for stowage planning. Also any waste / trash generated by the experiment needs to be identified for planning of dedicated handling and treatment.

4.7.1 Specification

4.7.1.1 Location

Three 4 PU lockers are foreseen to stow the MSG outfitting equipment. Two drawers are located in the rack left side under the DC / DC box, one drawer is located under the airlock, see Figure 1.3-2.

4.7.1.2 Exchangeability

For the drawers, the Standard Interface Rack (SIR) is used for the basic design, in order to be compatible with other drawers on the International Space Station. Internally, the drawers are custom designed to meet the design goals for MSG, namely to stow all necessary outfitting equipment, maintenance and spare items. The International Subrack Interface Specification (ISIS) may be the drawer interchange standard in the future, but final definition of this standard was not ready for implementation in the MSG drawers.

4.7.1.3 Interface to the Rack

The lockers slide into the MSG rack onto the SIR slides. The lockers are fixed at the front by means of the SIR handles.

The SIR slides can support active and passive drawers. MSG will be equipped with 3 passive drawers for stowage of MSG specific equipment, one drawer is dedicated to the optional video system.

4.7.2 Structural Description

In chapter 11 a drawing of the basic drawer assembly is presented. It consists of two folded sheet-metal plates, thickness 2 mm (TBC), combined with a stiffener on the bottom and two milled parts for the front and rear. The different parts will be riveted together.

Externally, the drawer interfaces to the slides are all the same; internally, each drawer is custom designed to meet the specific stowage requirements.

4.7.3 Dimensional Information

4.7.3.1 Available Internal Volume

Drawer	Intern. Depth	Intern. Height	Intern. Width	Intern. Volume
Standard 4PU	572 mm	159 mm	417 mm	0.038 m³

Table 4.7-1: Drawer Dimensions

The available payload envelope is shown in section 7.

4.7.3.2 Mass Budget

Total mass of the stowage items will not exceed 60 kg. The drawers themselves are not included.

The mass of the drawers will not exceed 8 kg each (System Spec. 3.6.2.1.2.1).

The total allowable mass for the outfitting equipment is 92 kg.

4.7.4 Stowage Method

The different items are stowed by means of foam supports into the different lockers. The foam type is neoprene HE/CR, which is not flammable and has a very slow aging process. Aging of foam is subject of two factors: light and oxygen. Since the stowage drawers will be closed most of the time, aging can be expected to be slow. However, it can be assumed that the foam will not keep its properties throughout MSG lifetime of 10 years, and therefore the stowage approach is designed in such a way that the foam is easily removable and exchangeable. The preventive maintenance aspects are described in the maintenance analysis, MSG-VE-TN-004, Issue B/1, October 1997.

This method is chosen because of several advantages with respect to other accommodation methods:

- possibility to stow any shape
- compliant with environmental loads
- allows easy one-hand operation
- possibility to reconfigure the stowage arrangement in-orbit

The relative disadvantages of this method, namely the large volume and mass of the foam, do not weigh up against these advantages.

For the stowage of the outfitting equipment into the foam, a 'package' approach is used. This principle is shown in Figure 4.7-1.

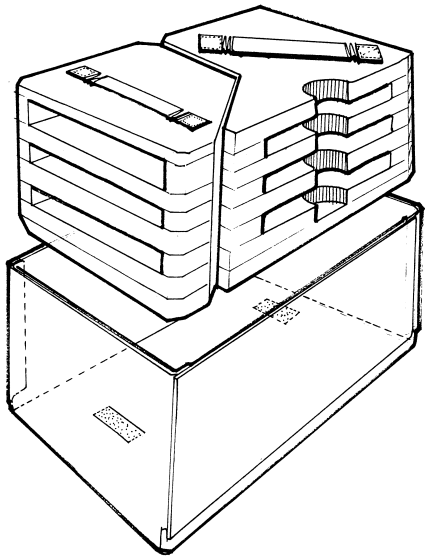


Figure 4.7-1: Stowage Package

Several units which are similar, e.g. filter caps, are placed into one holder package, which can be retracted from the drawer by one hand and then placed on the other packages (Velcro attachment). Then one of these items can be taken from the package and transferred to the work volume.

In order to use the full depth of the drawers, a second layer concept is implemented: This is illustrated in Figure 4.7-2. This approach is used for the Logistics Drawer (LGD) only, see the stowage drawings in chapter 11. In this way, the numerous spare seals could be stowed efficiently. For access of the items that are located under the seals, the ‘door’ can be opened by releasing the locking system, rotating it by 90°, and inserting it in the designated slot.

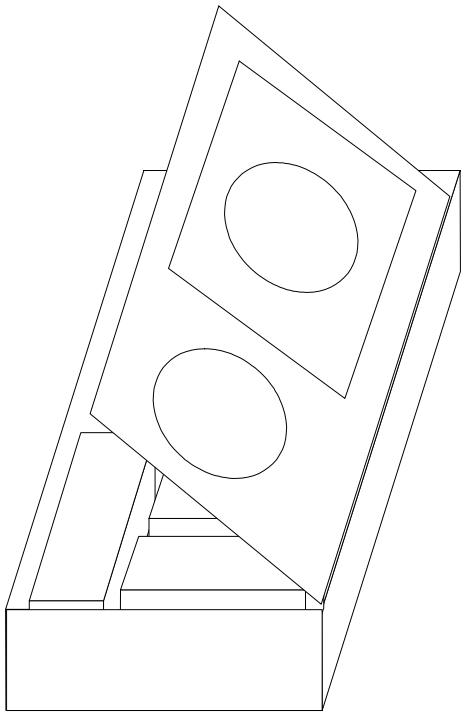


Figure 4.7-2: Second Layer Stowage Concept

4.7.5 Contents

4.7.5.1 General Description

The three MSG stowage drawers will contain the following items:

- consumables (tissues, cleaning sterets, ...)
- items required for on-orbit configuration and operation of MSG
- spares
- The drawers themselves will be classified according to the following criteria:
  - One drawer will be used for frequent (i.e. once every three months) up and downloading. This applies to the filters, waste, tissues, ziplock bags.
    Designation: Logistics drawer (LGD)

  - Drawer containing items for frequent use. This applies for gloverings, gloveport caps.
    Designation: Frequent Use Drawer (FUD)

  - Drawer for low frequent use, e.g. spare gloves, spare gloverings.
    Designation: Low Use Drawer (LUD)

  - The fourth drawer is designated for the implementation of the video equipment.

The next sections provide a listing of all items that will be stowed in the drawers. More elaborated descriptions on these items are given in section 4.7.7. Detailed information on how to use these items (operational and maintenance procedures) can be found in the final MSG Operations Manual.

4.7.5.2 Operational / Maintenance Items

1) Three plugs to plug off glove ports when not in use or in case of glove damage:
   - Two size 152.4 mm (glovebox)
   - One size 101.6 mm (airlock)
2) Two boxes of cleaning sterets (ethylene alcohol wipes)
3) Two boxes of tissues
4) Thirteen filtercaps:
   - Twelve filtercaps to block off the glovebox front filters
   - One filtercap to block off the airlock filter
5) One scavenger pump
6) One extension hose
7) One suction nozzle
8) Ten filter cartridges for liquid spills
9) Ten particle catchers
10) One cleaning nozzle
11) Waste bags (100)
12) Space for waste disposal

4.7.5.3 Outfitting Equipment

1) A flexible stray light cover to cover the whole screen in case an experiment requires a dark environment
2) Two pin cushions to be used inside the Work Area for temporary storage of small items, needles, scalpels, tools, etc.
3) Two spotlights
4) One spotlight cable
5) One small parts transport container
6) Four bungee cords
7) Set of experiment contra connectors
8) Tray
9) Goose neck
10) Labjack to facilitate experiment set-up, with a lifting height of 101.6 mm

4.7.5.4 Spare Parts

1) Twelve spare front filters
2) Gloverings, 152.4 mm
   - One pair with size 7 gloves
   - One pair with size 9 gloves
   - One pair with size 11 gloves
3) One gloverings, 101.6 mm with size 9 glove
4) Sixteen spare gloves:
   - Two pairs size 7
   - Four pairs size 9
   - Two pairs size 11
5) Double back tape
6) Lacing tape
7) Two spare batteries for the scavenger pump
8) Twelve spare seals:
   - Two seal rings 101.6 mm
   - Four seal rings 152.4 mm
   - Two seal rings 406 mm
   - One seal front door airlock
   - One seal top lid airlock

4.7.5.5 Budget Summary

Section 4.7.6 compiles all information about the quantity, mass and volume of the stowage items. Table 4.7-2 gives a summary thereof.

Drawer ID	Quantity	Mass	P/L volume
		[kg]	[l]
LGD	26	25.233	19.12
FUD	45	24.575	11.72
LUD	40	22.273	22.02
Video Drawer (TBC)	0	4	0
Total	**111**	**76.081**	**52.86**

Table 4.7-2: Summary of Stowage Items Budgets

Remark: The above mass budget of the contents of the drawers is conservative, because it is based on a 'full foam' approach, meaning that every space of the drawer which is not used by equipment, is filled by foam. Since this type of foam has a relatively high density (600 kg / m^3), the drawer mass is quite high as well. Optimization of the actually needed foam volume will decrease the total stowage mass substantially. The above numbers are used to obtain conservative structural analysis results as well.

4.7.6 Detailed Information Outfitting Equipment

The tables below give detailed information on the equipment to be stowed in the drawers. In section 7 the layout of the different drawers are given.

ID	Item	Qty	Unit Mass	Mass	Unit Volume	Volume
			(kg)	(kg)	(l)	(l)
FUD						
OI1	Gloveport plug, size 6" (glovebox)	2	0.314	0.628	0.64	1.28
OI3	Gloveport plug, size 4" (airlock)	1	0.172	0.172	0.31	0.31
OI6	Filtercap to block off the front filters (gbx)	12	0.070	0.840	0.22	2.64
OI7	Filtercap to block off the filter (airlock)	1	0.070	0.070	0.22	0.22
OI8	Scavenger pump	1	0.357	0.357	0.37	0.37
OI9	Extension hose	1	0.114	0.114	0.38	0.38
OI10	Suction nozzle	1	0.007	0.007	0.01	0.01
OI11	Filtercartridge for liquid spills	10	0.099	0.994	0.17	1.70
OI12	Particle catcher	10	0.003	0.026	0.02	0.20
OI13	Cleaning nozzle	1	0.100	0.100	0.01	0.01
OE1	Stray light cover	1	0.500	0.500	1.10	1.10
SP2	6" glovering with size 7 glove	1	0.250	0.250	0.94	0.94
SP3	6" glovering with size 9 glove	2	0.250	0.500	0.94	1.88
SP5	4" glovering with size 9 glove	1	0.250	0.250	0.68	0.68
FUD equipment total		**45**		**4.807**		**11.72**
	Stowage foam			15.768		26.28
	Drawer			4.000		
FUD drawer total				**24.575**		**38.00**

Table 4.7-3: FUD Drawer

ID	Item	Qty	Unit Mass	Mass	Unit Volume	Volume
			(kg)	(kg)	(l)	(l)
LGD						
OI4	Cleaning sterets, box (100)	1	1.000	1.000	2.71	2.71
OI5	Tissues, box (100)	1	0.507	0.507	2.27	2.27
OI14	Waste bags (100)	1	0.500	0.500	0.38	0.38
OI15	Space for waste disposal	1	0.500	0.500	1.90	1.90
SP1	Front filter	12	0.600	7.200	0.78	9.36
SP13	Seal ring 4"	2	0.010	0.020	0.09	0.18
SP14	Seal ring 6"	4	0.010	0.040	0.17	0.68
SP16	Seal ring 16"	2	0.010	0.020	0.76	1.52
SP17	Seal front door for AL	1	0.050	0.050	0.05	0.05
SP18	Seal top lid for AL	1	0.069	0.069	0.07	0.07
LGD equipment total		**26**		**9.905**		**19.12**
	Stowage foam			11.328		18.88
	Drawer			4.000		
LGD drawer total				**25.233**		**38.00**

Table 4.7-4: LGD Drawer

ID	Item	Qty	Unit Mass	Mass	Unit Volume	Volume
			(kg)	(kg)	(l)	(l)
LUD						
OI4	Cleaning sterets, box (100)	1	1.000	1.000	2.71	2.71
OI5	Tissues, box (100)	1	0.507	0.507	2.27	2.27
OE3	Pin cushion	2	0.100	0.200	0.10	0.20
OE4	Spotlight	2	0.200	0.400	0.08	0.16
OE5	Spotlight cable	1	0.050	0.050	0.19	0.19
OE6	Small parts transport container	1	0.300	0.300	0.95	0.95
OE7	Bungee cord	4	0.005	0.020	0.09	0.36
OE8	Set of experiment contraconnectors	1	0.250	0.250	0.95	0.95
OE9	Tray	1	1.500	1.500	1.09	1.09
OE10	Goose neck	1	1.000	1.000	0.40	0.40
OE11	Labjack	1	1.000	1.000	0.40	0.40
SP2	6" glovering with size 7 glove	1	0.250	0.250	0.94	0.94
SP4	6" glovering with size 11 glove	2	0.250	0.500	0.94	1.88
SP6	Glove without glovering, size 7	4	0.100	0.400	0.59	2.36
SP7	Glove without glovering, size 9	8	0.100	0.800	0.59	4.72
SP8	Glove without glovering, size 11	4	0.100	0.400	0.59	2.36
SP9	Double back tape	2	0.019	0.037	0.03	0.06
SP10	Lacing tape	1	0.005	0.005	0.00	0.00
SP12	Battery scavenger pump	2	0.033	0.066	0.01	0.02
LUD equipment total		**40**		**8.685**		**22.02**
	Stowage foam			9.588		15.98
	Drawer			4.000		
LUD drawer total				**22.273**		**38.00**

Table 4.7-5: LUD Drawer

4.7.7 Description of the Outfitting Equipment

4.7.7.1 Glove Port Plug

Gloveport plugs are used to temporarily close a gloveport, e.g. in case of a glove rupture. They are applied by simply pushing them into the glove port adapter.

4.7.7.2 Cleaning Sterets

Cleaning sterets consist of alcohol wipes for cleaning purposes.

4.7.7.3 Tissues

Tissues are used for all kinds of spillage removal.

4.7.7.4 Filter Caps

Filter caps are used to block off the front filters, in case this is required.

4.7.7.5 Scavenger Pump

The scavenger pump is capable of retrieving liquid that was spilled in the Glovebox work volume or in the airlock.

It is battery powered and its exchangeable cartridge is able of absorbing 20 ml of liquid.

One battery only is used in the scavenger pump, which consists of three cells of type Alk-Mn_2, size LF.

Drawings of the scavenger pump and its battery are included in section 7, Figure 4.7-3 shows the electrical schematic of the pump.

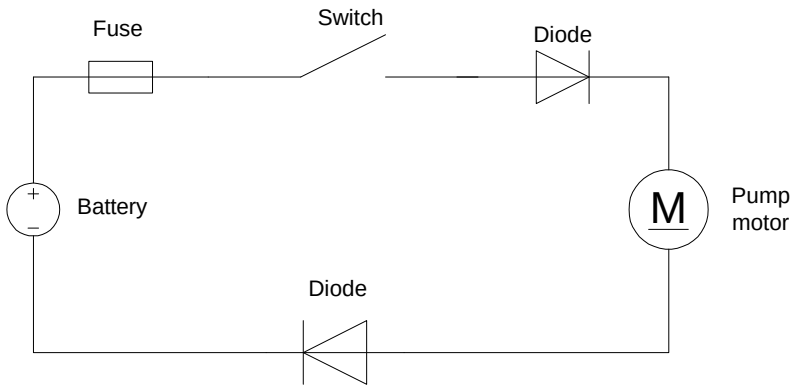


Figure 4.7-3: Scavenger Pump Schematic

4.7.7.6 Extension Hose

An extension hose is foreseen with the scavenger pump. It consists of a flexible hose attachment and allows retrieval of liquids in corners and grooves while the pump remains stationary.

4.7.7.7 Suction Nozzle

The suction nozzle allows penetration of the liquid drops.

4.7.7.8 Filter Cartridges

The cartridges are filled with desiccant pellets which can absorb up to 20 ml of liquid. The pellets change from white to a non-white color when they are wetted, and by visually inspecting the transparent cartridge the user can immediately see how much capacity is left. The cartridge is full when the non-white color has reached the 'Full' mark.

The cartridge is held in the pump by friction and can be removed by pulling it out. The liquid containment is maintained since all liquid has been absorbed by the pellets.

4.7.7.9 Cleaning Nozzle

The cleaning nozzle is an additional extension piece for the scavenger pump, which can be used for cleaning of the pip-pins. Figure 4.7-4 shows the cleaning nozzle.

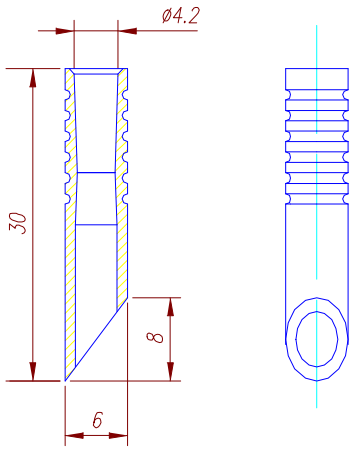


Figure 4.7-4: Cleaning Nozzle

4.7.7.10 Waste Bags

Waste bags are used for disposal of used tissues, cleaning sterets, etc. Each waste bag is 100 mm wide and 150 mm long. It is made of polyethylene, with a thickness of 50 µm.

4.7.7.11 Space for Waste Disposal

In the front of the LGD drawer, a large volume is reserved to contain the waste of MSG. A total of 5.5 l can be stowed. The waste disposal box has an access hole with a flexible entrance, which avoids the waste to come out of the disposal area.

4.7.7.12 Stray Light Cover

The stray light cover is used to darken the work volume 10,000 times (system spec. 3.2.1.3.10). It is made of a thin, flexible material (Kendex Seculto), which can easily be folded and stowed. The thickness of the cloth is 0.36 mm.

It is applied by Velcro strips all around the window surface, and by rubber (Latex) sleeves that go over the gloveport adapters. This principle is shown in Figure 4.7-5 for the side port stray light cover. The front window stray light cover is completely analogous, see section 7 for a drawing.

A camera window is foreseen in the stray light cover, which can be opened by removing the lid from the opening (the lid can be attached next to the window, see Figure 4.7-5).

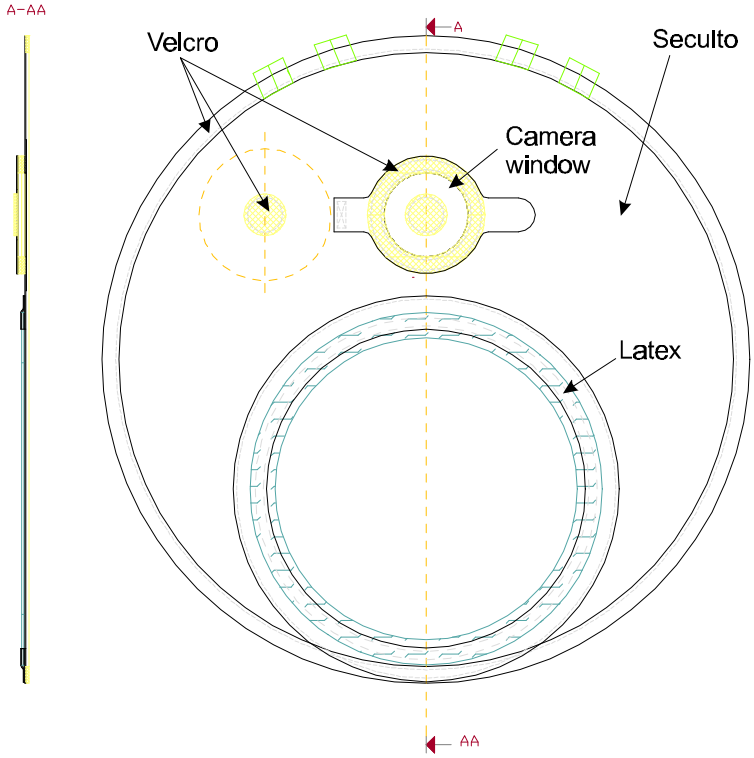


Figure 4.7-5: Side Port Stray Light Cover

4.7.7.13 Pin Cushions

Two pin cushions to be used inside the Work Area for temporary storage of small items, needles, scalpels, tools, etc. are provided.

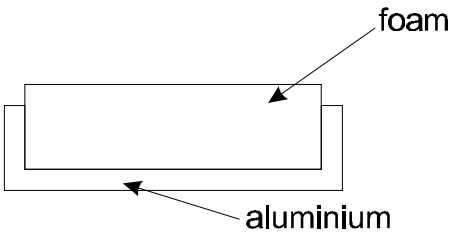


Figure 4.7-6: Pin Cushion

4.7.7.14 Spotlight

A spotlight is used to temporarily illuminate a specific area of the work volume, e.g. a payload connector. The spot is continuously variable in intensity by means of a manually operated iris in front of the light bulb, see Figure 4.7-7.

The intensity of the spot illumination will be up to 1,000 lux (system spec. 3.2.1.6.1.2)

The spotlight is powered by connecting a 1 m long cable to the ICP, thereby reaching any area in the work volume (system spec. 3.2.1.6.1.3). The connector at the back of the spotlight is of the Lemo EEG type.

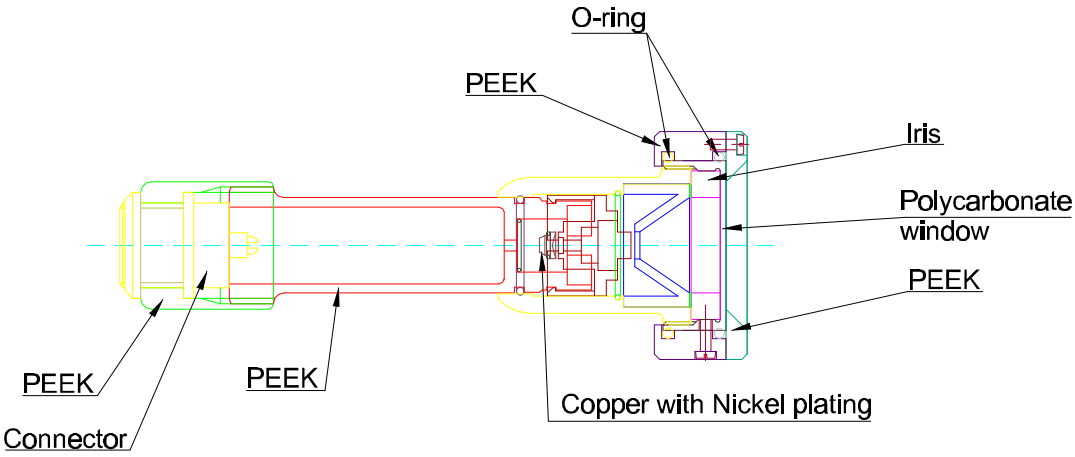


Figure 4.7-7: Spotlight

The spotlight can be attached to the goose neck for temporary storage, or to achieve a hands free spot illumination.

For thermal reasons the spotlight shall not be covered while it is on.

4.7.7.15 Small Parts Transport Container

A small parts transport container is used to transfer typically bolts, injection needles, etc. to the work volume. It consists of two cylindrical parts which can be screwed together (see Figure 4.7-8).

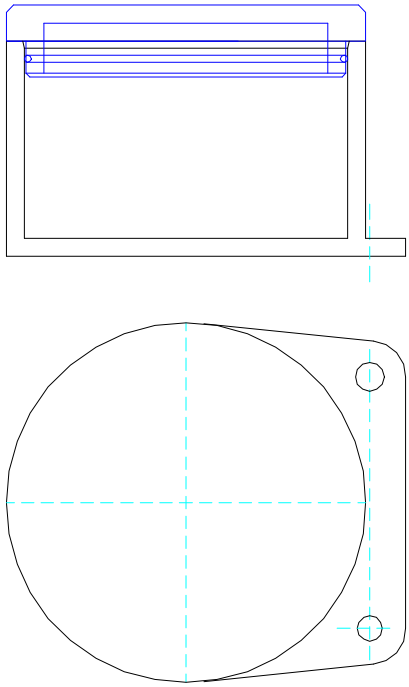


Figure 4.7-8: Small Transport Container

4.7.7.16 Bungee Cords

Four bungee cords will be provided for attachment of the equipment / experiment in the airlock and work volume.

4.7.7.17 Set of Experiment Contra Connectors

Five spare contra connectors (connector savers) are included in the stowage equipment:

- 2 of shell size 9
- 1 of shell size 15
- 1 of shell size 17
- 1 of shell size 19.

4.7.7.18 Tray

In principle, the tray will only be stowed during launch and landing of MSG. It is however possible to remove it from the airlock at all times. For a description of the tray, see section 4.1.4.2.2.

4.7.7.19 Goose neck

A goose neck, as shown in Figure 4.7-9 is included to attach small items like the spotlight temporarily in the work volume. The goose neck bottom flange can be attached to the standard pip-pin holes.

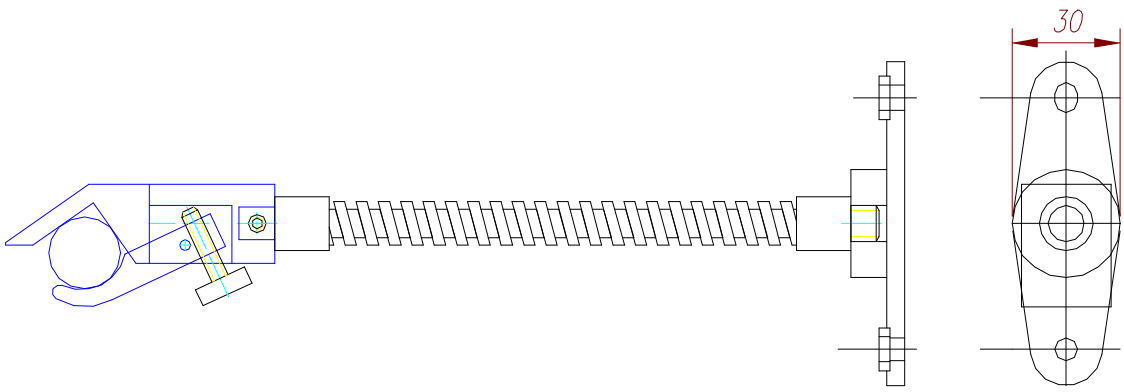


Figure 4.7-9: Goose Neck

4.7.7.20 Labjack

A labjack can be used to temporarily support small items in the work volume. The labjack can be adapted in height in the range of 38 mm to 114 mm. The dimensions of its support plate are 76 x 76 mm.

The labjack is made of rugged, chemical resistant anodized aluminium.

Figure 4.7-10: Labjack (Stowed Configuration)

4.7.7.21 Spare Front Filters

Twelve spare front filters for the glovebox work volume are provided.

4.7.7.22 Spare Gloverings

Six spare 152.4 mm gloverings are provided, each of them with a spare glove attached.

4.7.7.23 Spare Gloves

Sixteen spare gloves (without gloverings) are provided.

4.7.7.24 Double Back Tape

This tape is used to connect the spare gloves on the gloverings.

4.7.7.25 Lacing Tape

This tape is used to connect the spare gloves on the gloverings.

4.8 Materials and Parts

4.8.1 Materials and Processes Use and Selection

The MSG Work Volume is designed to handle up to 50 cc - if not stated otherwise - of the following listed materials (system spec. 3.2.1.11.7):

1) water
2) cleaning solvents as required for LSE, cleaning equipment
3) ethanol, butanol
4) methanol (limited to 20 cc),
5) decane, heptane
6) silicon oils (limited to 20 cc)
7) non-volatile combustible solid fuels: paper, polyethylene, PMMA (plexiglas)
8) glycerin
9) chlorofluorocarbons (refrigerants)
10) electrolytic fluids such as copper sulphate / acid solutions
11) polyethylene glycol
12) aqueous solutions with pH ranging from 3 to 9

4.8.1.1 Experiment Requirements

1) If experiments intend to use materials not on the above standard list, these materials need to be approved by the Safety Panel.
2) If experiments intend to use materials not on the above standard list, they have to provide for their own cleaning tools / wipes etc. in case of spillage and take care of waste disposal.
3) If experiments intend to use materials not on the above standard list, they have to verify that the gloves are compatible.
4) The experiments have to specify the materials to be dumped through the vacuum line.
5) If experiments dump toxic materials through the vacuum line they need to provide an absorbing filter.

4.8.2 Materials Documentation

The documentation requirements on the use of materials is currently TBD.

4.8.2.1 Experiment Requirements

TBD.

4.9 Safety

4.9.1 Fire Detection and Overheating Protection

The American Area Smoke Detection Assembly (ASDA) provides for smoke detection in the air circulation path of the MSG rack. The ASDA is mounted close to the air outlet of the Avionics Air Assembly (AAA) that provides for air circulation and cooling in the rack. The ASDA will be controlled by the ISS Caution & Warning system. The AAA and ASDA will be powered simultaneously with the MSG activation via the main power switch of the Remote Power Distribution Assembly (RPDA). Hence, air cooling and smoke detection are always active when the MSG is activated. The rack smoke detection is zero-fault tolerant.

Since loss of smoke detection will lead to a situation that smoke (fire) inside the rack cannot be detected, the MSG operation has to be terminated although no real hazard has been manifested.

Inadvertent activation of the smoke sensor caused by contaminated air from the WV entering the rack via the reference duct is excluded by the AHU filter performance.

The MSG rack provides two access ports for the ISS Portable Fire Extinguisher (PFEX). One of them is located at the front in the lower right part of the rack, the other one is at the lower left corner of the WV.

4.9.1.1 Fire Detection and Suppression in the WV

An investigation has been performed with respect to fire detection (ref. MSG-RIBRE-TN-0038 [RD 3]). The results are as follows:

- Smoke sensors in the AHU ducts cannot be used because the particles to be detected will be removed by the filters.
- The MSG itself provides no powered equipment inside the WV. Special features for power shut-down are provided by MSG for the 120 VDC power interface. Thus from MSG side a fire risk is not given.
- Combustion experiments are only acceptable under full crew surveillance.
- The WV is designed to contain a fire, taking into account an envelope of potential fire condition, specified by e.g. energy generation and energy distribution.
- A credible fire risk from the used experiment equipment has to be controlled by the experiment itself if exceeding the specified fire envelope conditions.
- Temperature sensors located at the air inlet of the AHU filters will be implemented to detect over-temperature possibly created by fire. The sensors trigger off a message to the ISS DHS via the 1553 MIL Bus.
- The MSG provides operational modes without airflow in the WV.

The WV provides a fire fighting hole to allow the use of the ISS PFEX. The hole is located at the lower left part of the front window. A fire fighting hole in the Airlock is not foreseen since there is no ignition source in the Airlock.

4.9.1.2 Experiment Requirements

1) For fire detection the requirements shall include as a minimum a temperature measurement in their experiment in compliance with NSTS 1700.7, ISS Addendum [AD 5]. Additional parameter monitoring depends on the experiment and has to be coordinated with the PSRP.
2) The experiments shall use materials and parts that meet the materials requirements specified in NSTS 1700.7, ISS Addendum [AD 5].

4.9.2 Waste Handling

MSG is providing means of waste handling:

1) A scavenger pump to clean up liquid spills and particles (section 4.7.7.5)
2) Waste bags to fill in and store waste created (section 4.7.7.10)

4.9.2.1 Experiment Requirements

1) Describe the amount and type of waste created
2) If experiments plan to create more waste than what is foreseen in section 4.7.7.11, they shall provide their own space for waste disposal.

4.9.3 Cleaning

General cleaning can be performed by using the cleaning provisions as provided as MSG specific outfitting equipment (see sections 4.7.6 and 4.7.7). The scavenger pump with its suction nozzle can be used to clean the pip-pin holes.

4.9.3.1 Experiment Requirements

1) If experiments intend to use materials not on the standard list (see section 4.8.1), they have to provide for their own cleaning tools / wipes etc. in case of spillage and take care of waste disposal (see section 4.9.2).

4.9.4 Ignition Sources

4.9.4.1 Experiment Requirements

1) The experiments shall control potential ignition sources, e.g. arcing / sparking, hot spots and electrostatic discharge, to not create a fire event (NSTS 1700.7 ISS Addendum [AD 5], §220.10a). Exceptions (e.g. for combustion experiments) have to be approved by the PSRP.

4.9.5 Experiment Grounding

4.9.5.1 Experiment Requirements

1) The experiments shall implement a grounding concept compliant with SSP 30240 [AD 12].

5 OPERATION

5.1 MSG Operational Modes

5.1.1 Normal Mode

In the Normal Mode, the GB is in an air-circulating loop, constantly filtering the internally circulated air of the WV and maintaining a pressure differential of at least 1.3 ± 0.5 mbar between the WV and cabin.

Three separate fans draw air through the Filter Banks, via the Heat Exchanger, through the Process Control Valves and via the Discharge Duct back into the WV.

The WV flow rate can be regulated by the fan speed. The negative pressure can be controlled by the Process Control Valves.

5.1.2 Open Mode

The glovebox switches to Open Mode in case a glove is ruptured or any other opening is created so that the negative pressure cannot be maintained in Normal Mode. Then the Process Control Valve closes and the fans are commanded to work on maximum speed.

All air leaves the GB via the reference duct outlet. If the pressure differential rises above 1.3 ± 0.5 mbar again, the GB automatically switches back to the Normal Mode. The pressure differential is continuously measured by pressure sensors and controlled by the CMP.

5.1.3 Sealed Mode

In the Sealed Mode, the Process Control Valves are closed, interrupting all airflow. The fans are off. The CMP commands Sealed Mode automatically when first powered up. This mode is also used for experiments not requiring air circulation in the WV.

Variations of air volume in the WV by e.g. movement of gloves, is compensated through the reference duct system. In Sealed Mode air can only escape from the WV through the filters into the reference duct.

The only entrance of air into the WV is through re-compression valve via the air discharge duct.

5.1.4 Donning Mode

For the Donning Mode the pressure differential inside the WV will be between 7 to 15 mbar, this will inflate the gloves making it easier to don or doff the gloves.

5.1.5 Automatic Pressure Control (APC)

Via the CMP it is possible to select the pressure inside the Work Volume. The CMP commands three Process Control Valves. The Process Control Valves are driven by a motor / reduction gear combination.

5.1.6 Manual Mode (APC Override)

An override switch for the APC system is implemented to operate in Manual Mode in case a pressure difference less than 1.3 mbar is required.

When the override is switched on, the air system has the same configuration and performance as in Normal Mode, except that the GB does not switch to Open Mode when the pressure difference decreases below 1.3 mbar. This implies that the override shall not be switched on if two levels of containment are required, since the negative pressure containment level cannot be ensured. A leak in the air circulation will not be detected when APC override is on.

5.2 Experiment Performance

5.2.1 Typical Airlock Operation

A typical flight operation procedure (FLOP) is given below. All other procedures are described in the relevant operations manual.

Nomenclature

 manual operation

 automatic operation

FLOP9	**Transferring a Small Experiment to the Work Volume**
	check if interlocking system is on
	open airlock front door (procedure FLOP1)
	adjust tray position if necessary (procedure FLOP7)
	insert experiment
	attach experiment to tray (procedure FLOP8)
	close airlock front door (procedure FLOP2)
	open airlock top lid (from within work volume) (procedure FLOP3)
	fasten airlock top lid (procedure FLOP4)
	loosen experiment from tray
	extract experiment from airlock
	fasten experiment in work volume (Bradford procedure)
	close airlock top lid (procedure FLOP6)

5.2.2 Airlock Maintenance Task

A typical maintenance procedure (MP) is given below. All other procedures are described in the relevant operations manual.

Nomenclature

 manual operation

 automatic operation

MP1	Replacing the Airlock Filter
	check if interlocking override is on
	open airlock front door (procedure FLOP1)
	adjust tray position if necessary (procedure FLOP7)
	turn filter counterclockwise until hard stop
	extract filter
	store used filter (procedure MP1)
	insert new filter
	turn filter clockwise until hard stop
	check if filter works correctly (green LED on CMP)
	close airlock front door (procedure FLOP2)
	put override function off

5.3 Servicing / Repair Operation

5.3.1 Example: Replacement of WV Filter

This section gives a description of the change out of a set of front filters.

The health of the front filters is monitored with a pressure sensor, a humidity sensor and a gas sensor.

If the pressure sensor indicates a pressure drop of less than [TBD] mbar over the front filters, this indicates that the front filter has tracking of the air flow. This means that the air flow is passing the filter with too little resistance because the filter malfunctions or because the filter is not properly installed. This can be solved by re-installing the filter or replacing it.

If the pressure drop over the filters is too high, this indicates that the filter is clogged. This can be solved by replacing the front filter with a new one.

The humidity sensor indicates if a filter bench is wet. In this case the Filters are limited in their drying capabilities. Also the CO conversion is degraded. The Gas sensors indicate if there is CO behind the filters. In this case the conversion function of the Filters is (partially) lost.

A typical change out of a filter is given in the following procedure.

Procedure for Front Filter Exchange		
	Step	**Action**
o	1.	INITIAL STATE: • Filters installed • MSG operating in Normal Mode
o	2.	Use the Airlock to bring a new, double bagged Front Filter inside the WV.
o	3.	Unbag the new filter.
o	4.	Restrain the new filter as well as the bags temporary inside the WV.
o	5.	Grasp the filter to be removed by the “peace sign” legs on the front of the filter.
o	6.	Rotate the filter counter clock wise until it stops (approximately 15°) and the lock indication is in line with the “unlock” sign on the filter Cover Plate.
o	7.	Place the primary packing bag over the filter.
o	8.	Pull out the filter in the primary packing bag.
o	9.	Close the primary packing bag.
o	10.	Restrain the primary packed filter temporary inside the WV.
o	11.	Grasp the new filter by the “peace sign” legs on the front of the filter.
o	12.	Guide the filter in the Filter Cover Plate with the “unlock” signs aligned until it reaches the end.
o	13.	Rotate the filter clock wise until it locks and the “lock” indications are lined up.
o	14.	Gently pull the filter toward yourself to verify that it is locked properly.
o	15.	Place the removed filter in the secondary bag and close.
o	16.	Use the airlock to remove the double packed dirty filter from the WV.
END OF PROCEDURE		

6 ABBREVIATIONS / ACRONYMS

6.1 Definition of Terms

Core Facility	The MSG core facility is the retractable part of the MSG rack, comprising the Work Volume, CMP, Airlock
ISPR	International Standard Payload Rack mechanical structure
MSG	Microgravity Science Glovebox system including rack, rack infrastructure and MSG components
MSG Components	MSG specific rack drawer, e.g. Glovebox, Airlock etc.
MSG Outfitting Equipment	MSG dedicated support equipment, e.g. stowage items

6.2 Abbreviation List

A

AAA	Avionics Air Assembly
AC	Alternating Current
ACS	Air Conditioning System
APM	Attached Pressurized Module
ASDA	Area Smoke Detector Assembly
AVECS	Adaptable VME-based Experiment Control System

B

BC	Bus Controller
BNC	Bayonet Network Connector

C

C&DH	Command and Data Handling
CMP	Control and Monitoring Panel
CSCU	Centralized Status and Control Unit
CVIU	Common Video Interface Unit
CWV	Central Work Volume

D

DAU	Decentralized Actuator Unit
DOC	Document
DSU	Decentralized Sensor Unit
DWG	Drawing
DHS	Data Handling System

E

EBox	Electronic Box
ECLS	Environmental Control and Life Support System
EEE	Electrical, Electronic and Electromechanical

EGSE	Electrical Ground Support Equipment
EPS	Electrical Power System
ESEM	Exchangeable Standard Electronic Module
EXPRESS	EXpedite the PRocessing of Experiments to Space Station

F

FCP	Function Control Panel
FDDI	Fiber Data Distributed Interface
FLOP	Flight Operation Procedure
FSK	Frequency Shift Keying
FUD	Frequent Use Drawer

G

GB	Glovebox
GSE	Ground Support Equipment

H

HRDL	High Rate Data Link
HX	Heat Exchanger

I

IAS	Internal Audio System
ICD	Interface Control Document
I/F	Interface
ISPR	International Standard Payload Rack
ISIS	International Subrack Interface Specification
ISS	International Space Station
ITCS	Internal Control System
IVS	Internal Video Subsystem

J

JEM	Japanese Experiment Module

L

LCD	Liquid Crystal Display
LED	Light Emitting Diode
LUD	Low Use Drawer

M

MED	Miscellaneous Equipment Drawer
MCS	Monitoring and Control Subsystem
MDM	Multiplexer / De-Multiplexer
MIL	Military
MRDL	Medium Rate Data Link
MSG	Microgravity Science Glovebox

N

N/A	Not Applicable
N/C	Not Connected
NPC	Negative Pressure Control
NSTS	National Space Transportation System

O

ORU	Orbital Replacement Unit

P

PAH	Payload Accommodations Handbook
PSRP	Payload Safety Review Panel

Q

QD	Quick Disconnect

R

RMA	Rack Maintenance Assembly
RPC	Remote Power Controller
RPCM	Remote Power Controller Module
RPDA	Remote Power Distribution Assembly
RT	Remote Terminal

S

SIA	Standard Interface Adapter
SPOE	Standard Payload Outfitting Equipment
SSP	Space Station Program

T

TBD	To Be Determined
TBC	To Be Confirmed
TCS	Thermal Control System

U

US Lab	United States Laboratory

V

V	Volt
VDC	Volts Direct Current
VU	Video Unit

W

W	Watt
WAIL	Work Area Inlet Louver
WV	Work Volume

7 Annex: Core Facility Drawings